

**12053**

Pigeonite Basalt  
879 grams

*DRAFT*

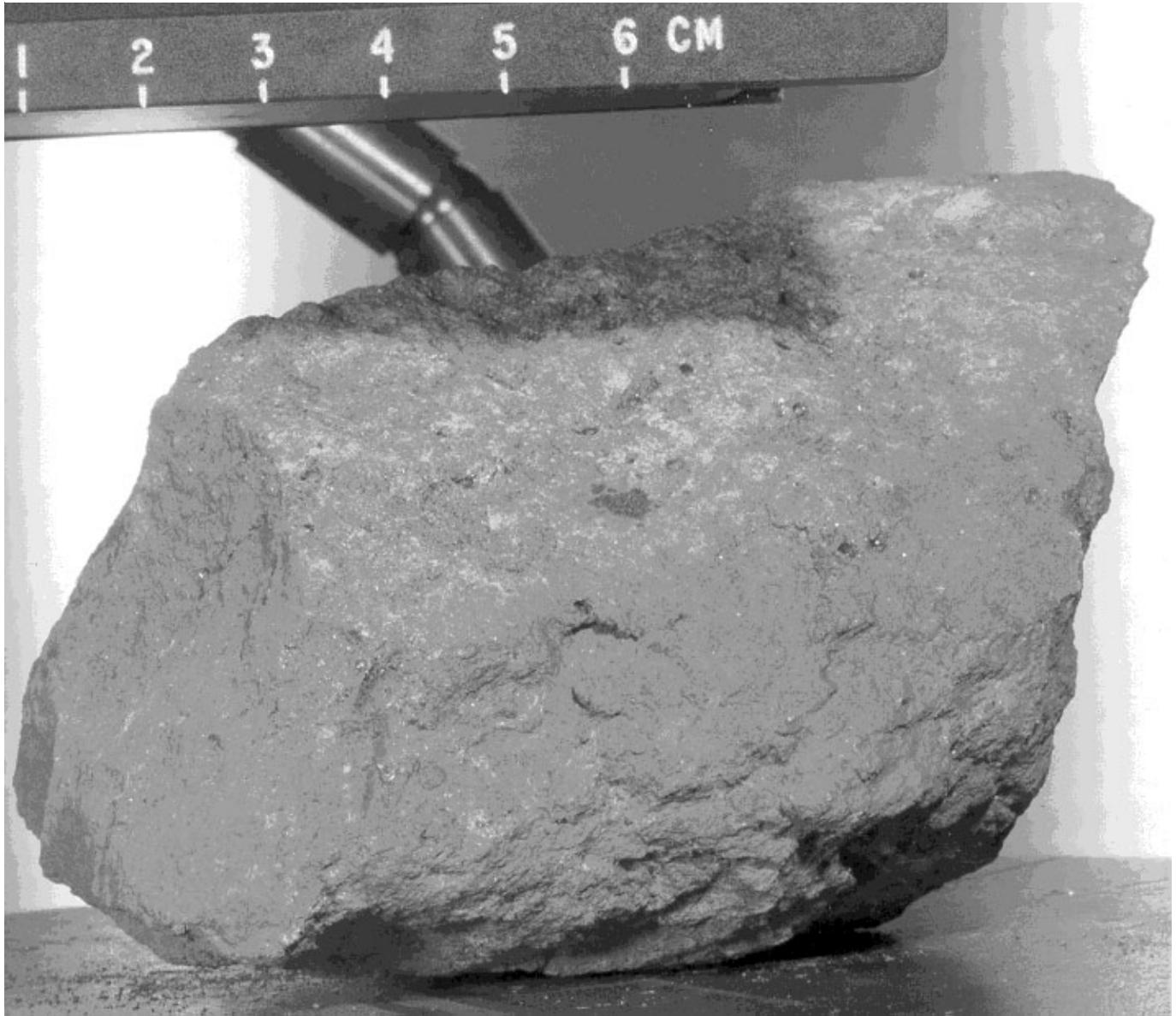


Figure 1: Photo of 12053,0 - about 9 cm across. NASA #S69-60624.

### **Introduction**

12053 is a porphyritic pigeonite basalt very like 12052 and 12055. It has been dated at 3.17 b.y. and has a cosmic ray exposure age of 130 m.y.

### **Petrography**

According to a brief description by Dence et al. (1971), 12053 is a "porphyritic variolitic basalt with zoned

pyroxene and minor olivine phenocrysts. It differs from 12021 mainly in having smaller phenocrysts of pyroxene and olivine as a second phenocryst mineral. Chromites enclosed in olivine are commonly euhedral and have thin discontinuous rim of ulvöspinel; chromite in clinopyroxene have more extensive and commonly complete ulvöspinel rims". Baldridge et al. (1979) describe 12053 as "porphyritic with fine-grained



Figure 2: Transmitted light photomicrograph of thin section 12053,75 showing long, hollow pyroxene phenocrysts in variolitic groundmass. Section is about 3 cm long. NASA #S70-36473.

variolitic groundmass (plagioclase laths 65 microns wide)”. Gay et al. (1971) shows remarkable, skeletal olivine.

### Mineralogy

**Pyroxene:** Pyroxenes in 12052, 12053 and 12055 are remarkable. They have hollow cores and are shaped like straws (figure 3).

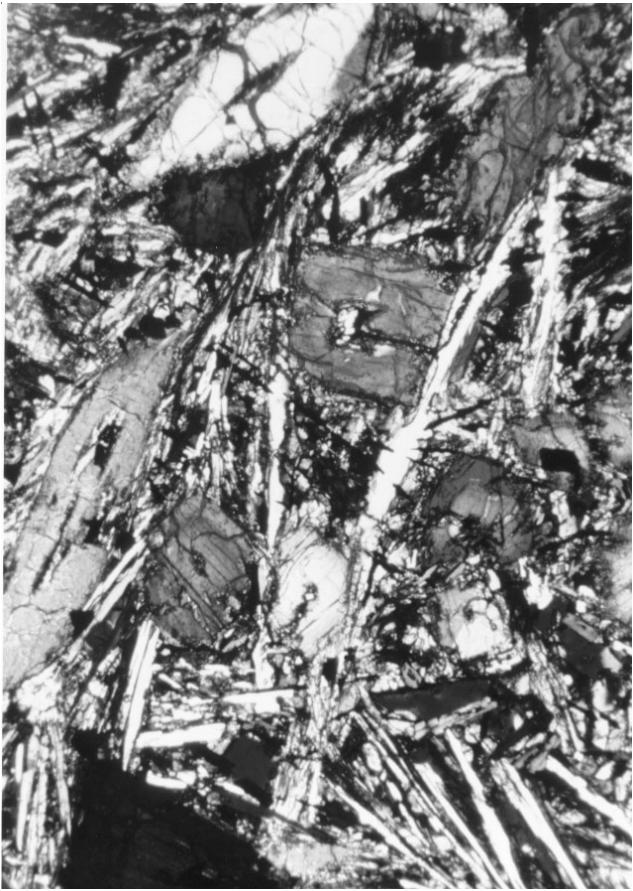
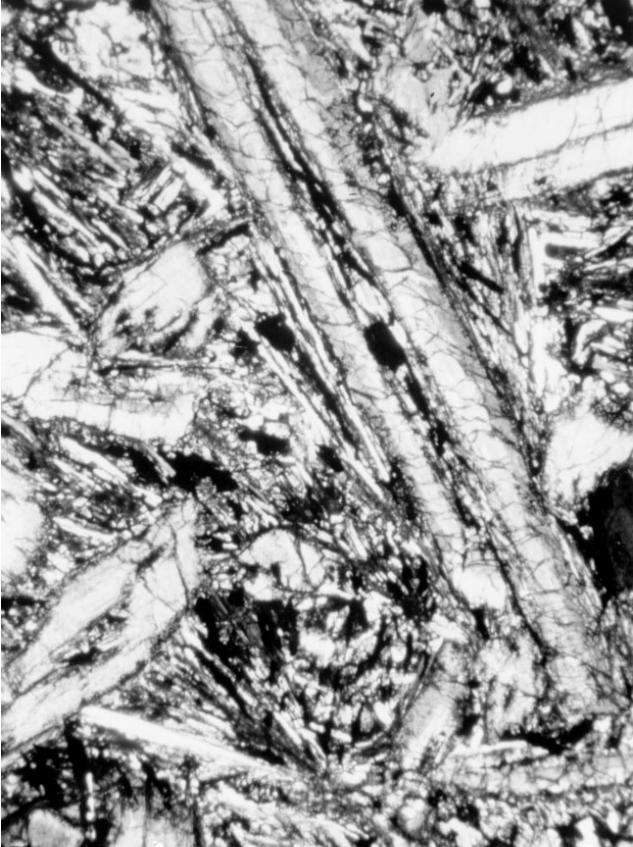


Figure 3: Transmitted-light and crossed-nicols of thin sections 12053,75 (top) and 12053,91 (bottom) showing chemically zoned, hollow, pyroxene phenocrysts (elongate and in cross section) set in variolitic groundmass.



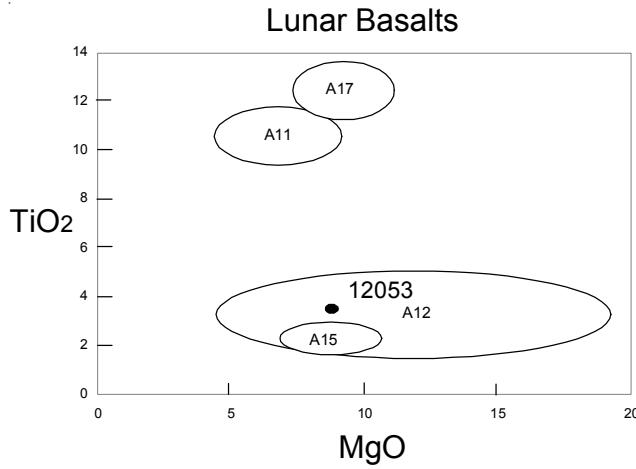


Figure 4: Composition of 12053 compared with that of other lunar basalts.

**Plagioclase:** Gay et al. (1971) find that plagioclase in 12053 is rather sodic ( $An_{70} - An_{78}$ ).

### Chemistry

Many investigators have determined the chemical compositions of these rocks (12052, 12053 and 12055)(table 1).

### Radiogenic age dating

Horn et al. (1975b) dated 12053 by whole rock Ar/Ar plateau age as  $3.17 \pm 0.06$  b.y.

### Cosmogenic isotopes and exposure ages

Burnett et al. (1975) determined an exposure age of  $130 \pm 20$  m.y. by  $^{81}\text{Kr}/^{83}\text{Kr}$ . Hintenberger et al. (1971) determined exposure ages for 12053 using  $^3\text{He}$  (77 m.y.),  $^{21}\text{Ne}$  (87 m.y.) and  $^{38}\text{Ar}$  (83 m.y.).

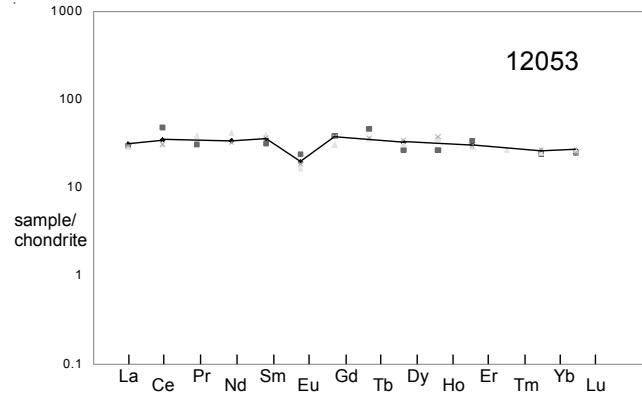


Figure 5: Comparison of rare-earth-element data for 12053 obtained by isotope dilution mass spectroscopy (line, Hubbard and Gast 1971, Wiesmann et al. 1975) with that obtained by neutron activation analysis (Morrison et al 1971, Wanke et al. 1971 and Haskin et al. 1971).

### Processing

12053 was cut with a circular saw (figure 6). Several slabs and short columns were produced. 12053,93 is on public display at the National Geographic Society in Washington DC (figure 7).

### List of Photo #s for 12053

S69-60621 – 60642	B & W mug
S69-60956	
S70-36968	processing
S70-35473	TS B & W
S70-49837 – 49840	TS color
S70-49541 – 49542	TS color
S70-49564 – 49565	TS color
S73-17984	display

### Mineralogical Mode for 12053

	Neal et al. 1994	Papike et al. 1976
Olivine	--	2
Pyroxene	67.1	68.8
Plagioclase	21.1	20.3
Opaques		8.3
Ilmenite	3.9	
Chromite +Usp	1.6	
mesostasis	4.6	0.6
"silica"	0.2	

### Summary of Age Data for 12053

Ar/Ar

Horn et al. 1975b  $3.17 \pm 0.06$  b.y.

**Table 1a. Chemical composition of 12053.**

reference weight	LSPET70 879 g	Gast70	Hubbard71 202 mg	Weismann75 202 mg	Willis71	Willis72	O'Kelly71 879 g	Morrison71
SiO <sub>2</sub> %					46.21 (c)			
TiO <sub>2</sub>		3.5 (b)			3.32 (c)		2.67 (e)	
Al <sub>2</sub> O <sub>3</sub>					10.14 (c)		11.34 (e)	
FeO					19.77 (c)		18.4 (e)	
MnO					0.28 (c)		0.28 (e)	
MgO					8.17 (c)		8.12 (e)	
CaO		10.6 (b)			11.01 (c)		9.66 (e)	
Na <sub>2</sub> O		0.31	0.27		0.26 (c)		0.26 (e)	
K <sub>2</sub> O	0.061 (a)	0.07 (b)	0.07 (b)	0.07 (b)	0.067 (b)	0.065 (c)	0.064 (a)	0.06 (e)
P <sub>2</sub> O <sub>5</sub>						0.14 (c)		
S %						0.08 (c)		
<i>sum</i>								
Sc ppm					50 (d)		46 (e)	42 (f)
V					148 (d)		170 (e)	140 (f)
Cr					3350 (c)		2200 (e)	
Co					30 (d)		36 (e)	36 (f)
Ni					10		39 (e)	42 (f)
Cu					26		24 (e)	
Zn					1.2		2.1 (e)	
Ga							2.9 (e)	
Ge ppb								
As							0.02 (e)	
Se								
Rb	1.24 (b)	1.24 (b)	1.24 (b)	1.24 (b)	1.1 (b)			1.2 (f)
Sr	130 (b)	130 (b)	130 (b)	130 (b)	111 (b)	114		120 (f)
Y					52	44.2		54 (f)
Zr					138	133	120 (e)	110 (f)
Nb					10	8.2		9.4 (f)
Mo							0.3 (e)	
Ru								
Rh								
Pd ppb								
Ag ppb								
Cd ppb								
In ppb								
Sn ppb								
Sb ppb							8 (e)	
Te ppb								
Cs ppm								0.07 (f)
Ba	84.4 (b)	84.4 (b)	84.4 (b)	84.4 (b)	86		86 (e)	89 (f)
La	7.26 (b)	7.32 (b)	7.32 (b)	7.32 (b)			6.4 (e)	6.9 (f)
Ce	20.9 (b)	20.9 (b)	20.9 (b)	20.9 (b)			27 (e)	19 (f)
Pr								3.5 (f)
Nd	15.3 (b)	15.3 (b)	15.3 (b)	15.3 (b)			17 (e)	19 (f)
Sm	5.25 (b)	5.25 (b)	5.25 (b)	5.25 (b)			5.4 (e)	5.9 (f)
Eu	1.1 (b)	1.1 (b)	1.1 (b)	1.1 (b)			0.96 (e)	0.93 (f)
Gd							6.7 (e)	6 (f)
Tb							1.3 (e)	1.3 (f)
Dy	8.01 (b)	8.01 (b)	8.01 (b)	8.01 (b)				7.5 (f)
Ho							1.8 (e)	2 (f)
Er	4.88 (b)	4.88 (b)	4.88 (b)	4.88 (b)				4.6 (f)
Tm							0.53 (e)	0.66 (f)
Yb	4.71 (b)	4.71 (b)	4.71 (b)	4.19 (b)	3.8 (b)	(d)	5.9 (e)	4.1 (f)
Lu	0.662 (b)	0.667 (b)	0.667 (b)	0.667 (b)			0.61 (e)	0.67 (f)
Hf				0.2 (b)			3.4 (e)	3.3 (f)
Ta							0.6 (e)	
W ppb							160 (e)	
Re ppb								
Os ppb								
Ir ppb								
Pt ppb								
Au ppb								
Th ppm	0.89 (a)						1.06 (a)	0.82 (e)
U ppm	0.25 (a)						0.28 (a)	0.24 (e)
<i>technique</i>	(a) radiation counting, (b) IDMS, (c) XRF, (d) emission spec., (e) INAA, (f) ms							

**Table 1b. Chemical composition of 12053.**

reference Wanke71 Haskin71

weight

SiO <sub>2</sub> %	47.28	(e)
TiO <sub>2</sub>	3.67	(e)
Al <sub>2</sub> O <sub>3</sub>	10.18	(e)
FeO	20.07	(e)
MnO	0.29	(e)
MgO	8.06	(e)
CaO	9.38	(e)
Na <sub>2</sub> O	0.3	(e)
K <sub>2</sub> O	0.06	(e)

P<sub>2</sub>O<sub>5</sub>

S %

sum

Sc ppm	56.4	(e)
V		
Cr	3480	(e)
Co	39.1	(e)
Ni	28	(e)
Cu	7.1	(e)
Zn		
Ga	4.1	(e)
Ge ppb	100	(e)
As	0.01	(e)
Se		
Rb	1.7	(e)
Sr	140	(e)

Y

Zr

Nb

Mo

Ru

Rh

Pd ppb

Ag ppb

Cd ppb

In ppb

Sn ppb	0.86	(e)
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Sb ppb

Te ppb

Cs ppm	0.1	(e)
Ba	100	(e)
La	7.07	(e)
Ce	30	(e)
Pr	2.8	(e)
Nd	15	(e)
Sm	4.7	(e)
Eu	1.34	(e)
Gd	7.6	(e)
Tb	1.73	(e)
Dy	6.53	(e)
Ho	1.49	(e)
Er	5.4	(e)

Tm

Yb	3.92	(e)
Lu	0.62	(e)
Hf	4	(e)
Ta	0.45	(e)
W ppb	120	(e)

Re ppb

Os ppb

Ir ppb	0.24	(e)
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Pt ppb	2.2	(e)
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Au ppb

Th ppm	0.87	(e)
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U ppm	0.242	(e)
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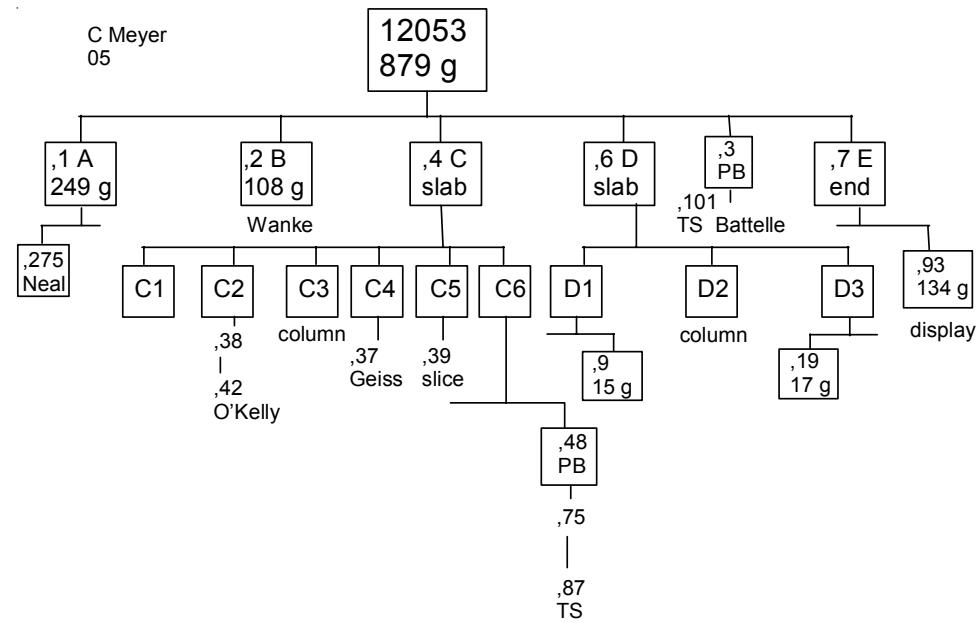
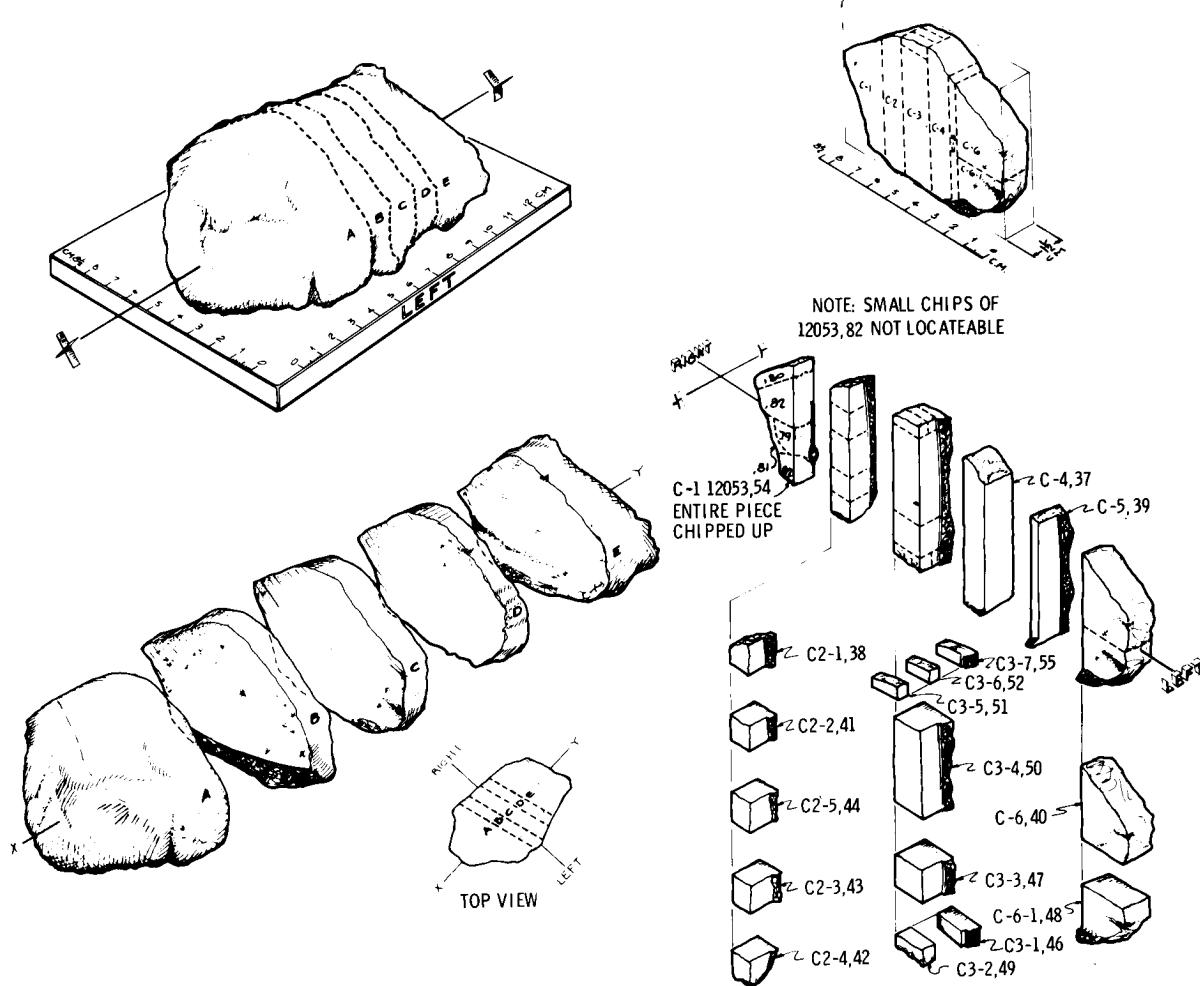
technique (a) radiation counting, (b) IDMS, (c) XRF, (d) emission spec., (e) INAA, (f) ms

THE CUTTING OF LUNAR ROCK NO. 12053

DRAWING COMPLETED MARCH 23, 1970

THE CUTTING OF SLICE 'C' NO. 12053,4

DRAWING COMPLETED MARCH 26, 1970



THE CUTTING AND BREAKING  
OF SLICE 'D' NO. 12053,6

DRAWING COMPLETED MARCH 30, 1970

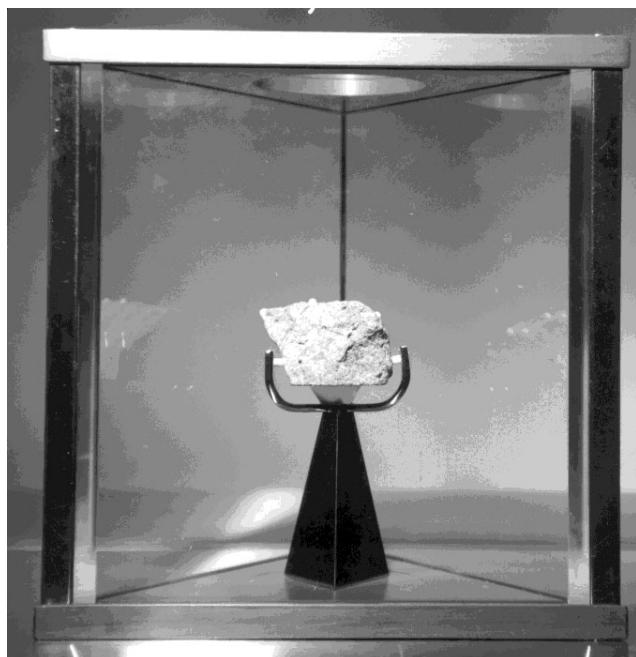
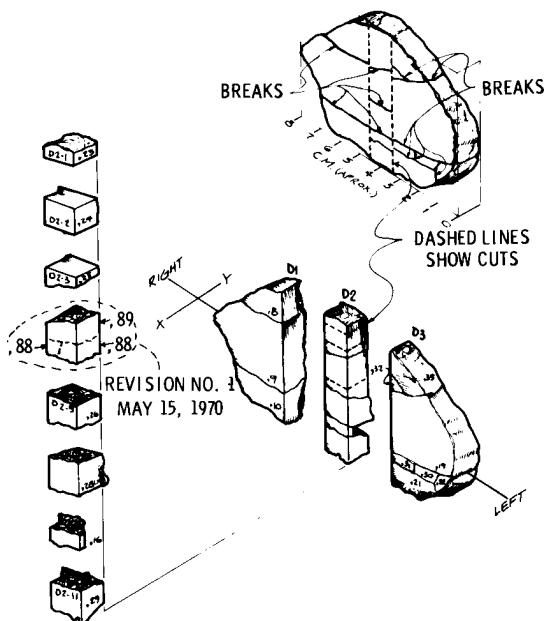


Figure 7: Display sample 12053,93. NASA #S73-17984.



Figure 6: Parts cut from slab D, 12053,6. Cubes are about 1 cm. NASA #S70-36968.